AMENDMENT TO THE SPECIFICATION

Please amend the paragraph starting at page 1, line 18 with the following:

As is well known, light absorption properties of the atmosphere define several frequency bands that are favorable to the transmission of light without undue absorption. Some of these frequency bands define spectral ranges that provide useful information for aiding in certain aspects of night vision. Generally, these spectral ranges may be described as the visible (VIS) band ~~(approximately 0.4μ – 0.76μ),~~(approximately 0.4μm - 0.76μm), the near infrared (NIR) band ~~(approximately 0.76μ – 1.1μ),~~(approximately 0.76μm – 1.1μm), the short wave infrared (SWIR) band ~~(approximately 1.1μ – 3μ),~~(approximately 1.1μm - 3μm), the medium wave infrared (MWIR) band ~~(approximately 3μ -7μ),~~(approximately 3μm - 7μm), and the long wave infrared (LWIR) band ~~(approximately 7μ -18μ).~~(approximately 7μm - 18μm). The VIS, NIR and SWIR bands are dominated by reflected light such as starlight. The LWIR band is dominated by emitted light, or thermal energy. The MWIR band has both reflected and emitted radiation, and exhibits approximately equal parts of reflected light and emitted light during the day.

Please amend the paragraph starting at page 12, line 24 with the following:

As illustrated in Figs. 2 and 3A, radiation propagating along an input axis 122 enters the sensor assembly 102 at the aperture 120 and passes through a common optical aperture, such as a single objective ~~lens 124A.~~ lens 124a. Parallax between the NIR sensor 116 and the LWIR sensor 118 is eliminated by allowing both the NIR and LWIR sensors 116, 118 to share a single aperture 120. It should be appreciated by those skilled in the art that the Figures 2-4B illustrate an infinite target on the optical axis, however in practice, a finite target may be viewed.

Please amend the paragraph starting at page 13, line 8, with the following:

The objective ~~lens 124A~~ lens 124a however, has a broad spectrum that is transmissive to

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VIS and NIR as well as LWIR spectral ranges. The VIS and NIR spectral ranges are approximately from 0.4μm to 1.1μm and the LWIR spectral range is from about 7μm to 18μm. As such, the objective ~~lens 124A~~ lens 124a has a sufficiently broad bandwidth to capture suitable amounts of radiation in the VIS, NIR and LWIR spectral ranges i.e. 0.4μm to 18μm. However, the objective ~~lens 124A~~ lens 124a need not cover precisely the entire VIS, NIR and LWIR bandwidth. For example, suitable optical materials for the objective ~~lens 124A~~ lens 124a may have a bandwidth of 0.48μm to 12μm. This is acceptable in part, because the LWIR sensor may only be sensitive to 8μm – 12μm.

Please amend the paragraph starting at page 13, line 18, with the following:

While not meant to be exhaustive, examples of materials suitable for constructing the objective ~~lens 124A~~ lens 124a include ZnSe ~~(0.48 μ to 22 μ),~~ (0.48μm to 22μm), $Ge_{33}As_{12}Se_{55}$ ~~(0.5 μ to 16 μ)~~ (0.5μm to 16μm) and $Ge_{28}Sb_{12}Se_{60}$ ~~(0.5 μ to 16 μ).~~ (0.5μm to 16μm). Because the above materials have a close refraction index (about 2.5) they are easily combined to make a lens. A preferred objective ~~lens 124A~~ lens 124a comprises a combination of three elements (ZnSe - $Ge_{33}As_{12}Se_{55}$ - ZnSe). Such an objective lens has good chemical, mechanical and thermal performance. An example of suitable construction characteristics for the objective ~~lens 124A~~ lens 124a includes a focal length of f=16mm, an f number F=1.0, field of view (FOV) of 54 degrees x 42 degrees, and a Modulation Transfer Function (MTF) of 60% on the center, and 30% on the edge. These parameters, while only illustrative, enable the objective ~~lens 124A~~ lens 124a to be compatible with current commercially available LWIR and NIR sensors. It will be appreciated that other parameters are possible. The objective ~~lens 124A~~ lens 124a should also further exhibit a sufficient back working distance for the sensors utilized. For example, a back working distance b=13.2 mm allows suitable room to further insert a chopper or other necessary components for the LWIR sensor 118 as more fully explained herein.

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Please amend the paragraph starting at page 14, line 6 with the following:

The preferred composite construction of the objective ~~lens 124A~~ lens 124a (ZnSe - $Ge_{33}As_{12}Se_{55}$ - ZnSe) solves many problems associated with a typical Ge lens. Notably, the Ge lens is expensive and further may turn opaque when the environmental temperature rises to 120 degrees Celsius. The objective ~~lens 124A~~ lens 124a according to the preferred construction may withstand temperatures to 374 degrees Celsius prior to turning opaque, and has about 1/3 the cost of the Ge lens.

Please amend the paragraph starting at page 14, line 13 with the following:

Referring generally to Figs. 2 and 3A, an optical aperture such as a beam splitter 126 that is reflective of radiation in the LWIR spectral range, and transmissive of radiation in the VIS and NIR spectral ranges is mounted behind the objective ~~lens 124A.~~ lens 124a. The beam splitter 126 reflects radiation in the LWIR spectral range from the objective ~~lens 124A~~ lens 124a towards the LWIR sensor 118. Similarly, the beam splitter 126 transmits radiation in the VIS/NIR spectral ranges to the NIR sensor 116. Depending upon the orientation of the LWIR sensor 118 with respect to the beam splitter 126, a reflective surface such as a mirror 128 is mounted between beam splitter 126 and LWIR sensor 118 such that radiation in the LWIR spectral range entering through the aperture 120 passes through the objective ~~lens 124A,~~ lens 124a, is reflected in turn by the beam splitter 126, then by the mirror 128 towards LWIR 118. A beam splitter as used herein is any ~~structure such as an optical aperture that is transmissive~~ structure, such as an optical aperture, that is transmissive of radiation in at least a portion of one spectral range, and reflective of radiation in at least a portion of a second spectral range different from the first spectral range. For example, the beam splitter 126 may be formed ~~for example~~ from a dielectric material deposited on a glass substrate, or otherwise coated by a transmissive waveband ~~filter of 0.48μ-1.1μ and a reflective waveband filter of 8μ-12μ.~~ filter of 0.48 μm-1.1 μm and a reflective waveband filter of 8 μm-12 μm.

Please amend the paragraph starting on page 15, line 2 with the following:

The beam splitter 126 is preferably fully transmissive of radiation in the VIS and NIR spectral ranges, and fully reflective of radiation in the LWIR spectral range. However, it is within the spirit of the present invention to construct the beam splitter 126 so as to be only partially transmissive and/or partially reflective. Further, those skilled in the art will appreciate that the NIR and LWIR sensors 116, 118 may be reversed such that the beam splitter 126 is reflective of radiation in the VIS/NIR spectral ranges, and transmissive of radiation in the LWIR spectral range. It will be observed that the NIR sensor 116 and the LWIR sensor 118 are arranged such that they share the same field of view and are focused along the common input axis 122. Therefore, NIR and LWIR sensors 116, 118 generate image data representative of the NIR and the LWIR radiation, respectively, emanating from the same scene. As such, parallax between the NIR sensor 116 and the LWIR sensor 118 is eliminated. Further, because the NIR sensor 116 and the LWIR sensor 118 shares the same objective ~~lens 124A,~~ lens 124a, there is unity of magnification between the NIR and LWIR sensors 116, 118, thus improving the readability of sensor data.

Please amend the paragraph starting at page 15, line 18 with the following:

The outputs of the NIR and LWIR sensors 116, 118 may optionally be fused together for viewing as illustrated in Fig. 3B. Radiation propagating along input axis 122 enters the sensor assembly 102 at aperture 120 and passes through the single objective ~~lens 124A~~ lens 124a as described above. The beam splitter 126 as illustrated in Fig. 3B is transmissive of radiation in the VIS/NIR spectral ranges and reflective of radiation in the LWIR spectral range. Radiation in the VIS/NIR spectral ranges passes through lens 115 before entering the NIR sensor 116. The VIS/NIR ~~radiation exit the~~ radiation exits the NIR sensor 116 as a visible image that is passed through lens 127. Lens 115 and 127 are optional, and are used to correct aberrations and achieve

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a high-resolution image. Construction of lenses 115 and 127 may be of a normal glass material. The NIR sensor 116 is preferably implemented as an image intensifier tube or a low light level Charge Couple Device (CCD).

Please amend the paragraph starting on page 16, line 12 with the following:

A beam combiner 129 is used to fuse or integrate the VIS/NIR radiation rendered visible by the NIR sensor 116, and the LWIR radiation rendered visible by the LWIR sensor 118. In a preferred structure, the peak responsive wavelength of the image intensifier tube used for the NIR ~~sensor 116 is 0.85μ.~~ sensor 116 is 0.85μm. The image intensifier tube converts the radiation to green light at peak ~~wavelength of 0.55μ with~~ wavelength of 0.55μm with very narrow bandwidth. The beam combiner 129 passes 100% green light ~~at 0.55μ with a bandwidth of only +/-0.01μ from~~ at 0.55μm with a bandwidth of only +/-0.01μm from the NIR sensor 116, and reflects all other visible light from the LWIR sensor 118. As such, high intensity images from both channels are achieved.

Please amend the paragraph starting on page 17, line 6 with the following:

Because visible images of the radiation in NIR and LWIR spectral ranges are optically combined, the sensor assembly 102 may optionally project the combined image directly onto the user's eye. As such, lens 127 serves as an eyepiece. The mirror 125 can be placed in the front or behind the lens 127 depending on the system structure. It will be observed that the use of a single lens 127 as an eyepiece allows the use of a monocular optical viewer such as that illustrated in Fig. 1B, or as a binocular optical viewer (not shown). ~~As illustrated in Fig. 1B, the lens 127~~ The lens 127 (not shown in Fig. 1B) is housed within the optical viewer 102A. An optional focus knob 103 may further be provided to focus the image. Where a binocular view is desired, the image is copied, ~~reflected through a prism for example.~~ such as by reflecting the image through a prism, for example. The copied image is viewed through a second optical

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viewer (not shown). The optical viewers are positioned to suitably line up with the eyes of a user, and may include adjustments to allow a user to align the optical viewers as desired. Alternatively, a binocular optical viewer may comprise a second image intensifier tube, that is, the radiation is passed through two NIR sensors (not shown) as well as the LWIR sensor 118.

Please amend the paragraph starting on page 17, line 22 with the following:

The transmittance of radiation in the NIR spectral range for the single objective ~~lens 124A~~ lens 124a illustrated in Figs. 3A and 3B may not be as good as that of glass. Further, in some circumstances, for example where an objective ~~lens 124A~~ lens 124a according to the preferred construction cannot be manufactured, it may be desirable to use commercially available lenses.

Please amend the paragraph starting on page 18, line 9 with the following:

Referring back to Fig. 4A, the beam splitter 126 is mounted between the aperture 120 and an optical aperture, such as objective ~~lens 124B.~~ lens 124b. The objective ~~lens 124B needs~~ lens 124b need only be transmissive to radiation within the LWIR spectral range. Similarly, the beam splitter 126 reflects radiation in the VIS/NIR spectral ranges to an optical aperture such as objective ~~lens 124C. The objective lens 124C needs~~ lens 124c. The objective lens 124c need only be transmissive to radiation within the VIS/NIR spectral ranges.

Please amend the paragraph starting on page 18, line 16 with the following:

It is preferable that the two objective ~~lenses 124B and 124C are~~ lenses 124b and 124c are optically similar. The phrase optically similar is defined herein to mean that the two objective ~~lenses 124B, 124C are~~ lenses 124b, 124c are constructed to include generally identical focal lengths, F-numbers, Field of view, MTF and back working distance. This will ensure that the NIR sensor 116 and LWIR sensor 118 depict images of the same scene. Depending upon the

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orientation of the NIR sensor 116 with respect to the beam splitter 126, a mirror 128 is mounted between beam splitter 126 and NIR sensor 116 such that radiation in the VIS/NIR spectral ranges entering through the aperture 120 is reflected by the beam splitter 126, passes through the objective ~~lens 124C,~~ lens 124c, and reflects off mirror 128 towards NIR sensor 116. Those skilled in the art will appreciate that the NIR and LWIR sensors 116, 118 may be reversed such that the beam splitter 126 is reflective of radiation in the LWIR spectral range, and transmissive of radiation in the VIS/NIR spectral ranges.

Please amend the paragraph starting on page 18, line 28 with the following:

The images may further be combined optically as illustrated in Fig. 4B. Radiation enters the aperture 120 along a common optical axis 122. The beam splitter 126 is transmissive to radiation in the VIS/NIR spectral ranges, and reflective of radiation in the LWIR spectral range as illustrated. Radiation in the VIS/NIR spectral ranges are transmitted by the beam splitter 126 through the filtering objective ~~lens 124B~~ lens 124b and into the NIR sensor 116, implemented as an image intensifier tube or LLL CCD for example.

Please amend the paragraph starting on page 19, line 8 with the following:

Radiation in the LWIR spectral range reflected by the beam splitter 126 is further reflected by the mirror 128 and passes through the filtering objective ~~lens 124C~~ lens 124c before entering the LWIR sensor 118. The optical fusion of the NIR and LWIR images is otherwise identical to that described with reference to Fig. 3B. That is, the LWIR sensor 118 converts radiation in the LWIR spectral range to a visible image which is transmitted through lens 123, reflected off of mirror 125 and is combined with a visible image of radiation in the NIR spectral range which has been output by the NIR sensor at the beam combiner 129.

Please amend the paragraph starting on page 19, line 17 with the following:

Referring back to Fig. 2, although illustrated with the single objective ~~lens 124A~~ lens 124a as described with reference to Figs. 3A and 3B, it should be observed by those skilled in the art that the objective ~~lens 124A~~ lens 124a may be replaced with objective ~~lenses 124B, 124C~~ lenses 124b, 124c as described with reference to Figs. 4A and 4B. Radiation enters the aperture 120 passing ~~through lens130.~~ through lens 130. An optical window 132 with a focusing knob 166 and a lens cap (not shown in Fig. 2) is provided to protect the sensor assembly 102. For example, a thin optical window of Si, Ge, or hot pressed ZnSe or ZnS is placed in the front of the objective ~~lens 124A.~~ lens 124a. The hot pressed ZnSe has good mechanical as well as thermal properties including a high resistance to delaminating, cracking, pitting, scratching and staining. The sensor assembly 102 may further include an iris 134 or other focus adjustments depending upon the types of NIR and LWIR sensors 116, 118 implemented.

Please amend the paragraph starting on page 20, line 12 with the following:

LWIR sensor 118 may be implemented as any sensor sensitive to LWIR reflected radiation. As illustrated in Fig. 2, the LWIR sensor 118 is implemented as an uncooled focal plane array (UFPA). The UFPA may be implemented for example using either VO_x Microbolometer (MBT), Silicon Microbolometer, or Barium Strontium Titanate (BST) technology. For example, the MBT and BST may provide an image having a 320x240 pixel resolution, with either ~~a 50 μ or 25 μ pixel size. The 25 μ pixel~~ a 50μm or 25μm pixel size. The 25μm pixel size allows a much smaller footprint where miniaturization is critical. The UFPA is arranged to include 320 row detectors and 240 column detectors, bump bonded to a silicon readout circuit using Indium bumps. The readout circuitry is a silicon IC that includes a sense amplifier (one per pixel), a column multiplexer switch (one per column), a column amplifier (one per column) and row multiplexer switch (one per row).

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Please amend the paragraph starting on page 20, line 24 with the following:

The UFPA is typically packaged in a ceramic enclosure and sealed in a vacuum with an optical window. A thermoelectric cooler or TE cooler (TEC) is integral to the package. The TEC stabilizes the detector temperature at a near room temperature (22 degrees Celsius for example for BST), thus a cryogenic cooling device is not necessary. Further, the TEC is not necessary when using a Si-Bolometer. The objective ~~lens 124A~~ lens 124a has enough back working distance (for example 13.2 mm in this preferred embodiment) to insert not only the beam splitter 126, but also a chopper for BST or other alternating AC coupled devices.

Please amend the paragraph starting on page 21, line 14 with the following:

~~There are three types of common optical aperture disclosed herein.~~ The single transmissive common objective lens with single beam splitter is illustrated with reference to Figs. 3A and 3B. The single transmissive beam splitter with two objective lenses is illustrated with reference to Figs. 4A and 4B. ~~The third type of common optical aperture is a single reflective objective lens with a single beam splitter, and is illustrated in Fig. 5.~~

Please amend the paragraph starting on page 21, line 21 with the following:

Referring to Fig. 5, radiation propagating along an input axis 122 enters the sensor assembly 102 at the aperture 120. ~~aperture 120 and reflects off of the reflective optical aperture, such as objective lens 124D. The objective lens 124D is preferably a reflective concave mirror that collects the radiation from VIS spectral range to LWIR spectral range. The radiation then reflects off of mirror 128 towards the beam splitter 126.~~ The beam splitter 126 ~~transmits~~ reflects radiation in the LWIR spectral range from the mirror 128 towards the LWIR sensor 118. For example, radiation in the spectral ~~range of 8μ to 12μ enters~~ range of 8μm to 12μm enters an uncooled focal plane array (UFPA) that converts the optical image to an electrical image. Similarly, the beam splitter 126 ~~reflects~~ transmits radiation in the VIS/NIR spectral ranges to the

NIR sensor 116. For example, the beam splitter 126 ~~reflects~~ <u>transmits</u> radiation in the spectral ~~range of 0.48μ to 1.1μ to~~ <u>range of 0.48μm to 1.1μm to</u> an I^2 tube. A CCD camera behind the I^2 tube converts the optical image to an electrical image.

Please amend the paragraph starting on page 22, line 14 with the following:

It shall be appreciated that other viewing options may be used within the spirit of the present invention. ~~Further, the design illustrated with reference to Fig. 5 does not have color aberration and further exhibits high reflectance for VIS, NIR and LWIR radiation, however the field of view is narrow and volume is relatively big. As such, where size is of primary concern, the transmissive common aperture objective lens discussed with reference to Fig. 3 may be preferred.~~

Please amend the paragraph starting on page 22, line 22 with the following:

Referring to Fig. 6A, the sensor assembly 102 may be arranged to provide both an optical view of the target image as well as an electronic view of the target image. ~~Initially, It will be observed that while Fig. 6A illustrates the beam splitter embodiment, It will be observed that any of the embodiments disclosed herein, including the common objective lens may be used, so long as a common aperture is used for both sensors 116, 118 as more fully described herein.~~ W<u>hile Fig. 6A illustrates the beam splitter embodiment, any of the embodiments disclosed herein, including the common objective lens may be used, so long as a common aperture is used for both sensors 116, 118 as more fully described herein.</u>

Please amend the paragraph starting on page 22, line 28 with the following:

As described more fully above, radiation propagating along the input axis 122 enters the sensor assembly 102 at aperture 120. Radiation in the VIS/NIR spectral ranges are transmitted by beam splitter 126, passes through the objective ~~lens 124B~~ <u>lens 124b</u> and into the NIR sensor

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116 (such as an image intensifier). The image exits the NIR sensor 116 and passes through a splitter 131 where a copy of the image is transmitted through the lens127 to the optical viewer 102A. Therefore, high resolutions can be maintained.

Please amend the paragraph starting on page 23, line 7 with the following:

A second copy of the image from the NIR sensor 116 is reflected off mirror 133, and is transmitted through lens 135 to a CCD camera 138. It will be observed that the splitter 131 may be implemented as a beam splitter, a prism or other similar device capable of duplicating an optical image. For example, the splitter 131 is used such that 80% of the radiation is imaged upon the user's eye through lens 127 and optics viewer 102A. The remaining 20% of the radiation is reflected off of the mirror 133, through lens 135 and onto the charge coupled device (CCD) 138. Camera 138 converts the optical image to an electronic image. The output of the CCD is coupled to data fusion, and other processing circuitry 139.

Please amend the paragraph starting on page 23, line 17 with the following:

Radiation in the LWIR spectral range is reflected by the beam splitter 126, reflected by the mirror 128, transmitted through the objective ~~lens 124C~~ lens 124c and enters the LWIR sensor 118. The LWIR sensor as illustrated in Fig. 6A will not have an optically viewed component. As such, a device such as display device 121 as illustrated in Figs. 3B and 4B is not required. However, the LWIR sensor 118 includes a UFPA 119 or other similar device capable of converting radiation in the LWIR spectral range to an electronic signal. Further electronics may also be included for signal conditioning and further processing.

Please amend the paragraph starting on page 24, line 10 with the following:

Referring to Fig. 6B, the sensor device 102 is similar to the embodiment described with respect to Fig. 6A, however, the optical viewer 102A displays an image fused from radiation in

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the VIS/NIR and LWIR spectral ranges. Radiation propagating along the input axis 122 enters the sensor assembly 102 at aperture 120. Beam splitter 126 transmits radiation in the VIS/NIR spectral ranges through the objective ~~lens 124B~~ lens 124b and into the NIR sensor 116. The image exits from the NIR sensor 116 and passes through a prism 131 where a copy of the image is transmitted through the lens127 to the optical viewer 102A. A second copy of the image from the NIR sensor 116 is reflected off mirror 133, transmitted through lens 135 to camera 138. Camera 138 converts the optical image to an electronic image. Further, electronics may be provided for signal processing and conditioning. The output of the camera 138 is sent to the wireless transmitter 143.

Please amend the paragraph starting on page 24, line 23 with the following:

Radiation in the LWIR spectral range is reflected by the beam splitter 126, reflected by the mirror 128, is transmitted through the objective ~~lens 124C~~ lens 124c and enters the LWIR sensor 118. The LWIR sensor 118 as illustrated in Fig. 6B includes a UFPA 119 or other similar device capable of converting radiation in the LWIR spectral range to an electronic signal (further electronics may also be included for signal conditioning and further processing) as well as a display device 121 such as described with reference to Figs. 3B and 4B. A copy of the output of the UFPA 119 is sent to the wireless transmitter 143 through electronics. Further, a visible image from the display device 121 is transmitted through lens 123, is reflected off mirror 125 to beam combiner 129, and is sent to the optical viewer 102A to fuse the VIS/NIR image optically.

Please amend the paragraph starting on page 29, line 6 with the following:

Referring to Fig. 8, in order to protect the sensor assembly 102, a high strength plastic or other suitable material may be used to form an envelope 168 for the aperture 120, camera 102C and display device 102D. On the inner surface of the envelope 168, a thin layer of metal net (not shown) is molded to shield against magnetic electrical radiation. Further, the use of materials

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such as foam spacers (not shown) and lens cap 170 may be used to protect the sensor assembly 102 against vibration and impact. The Iris 134 and focus/adjust knobs 166 are the only items outside the envelope 168, and these items are positioned at the frontier of the objective ~~lens 124A.~~ lens 124a.